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Paramount factors influencing the breeding performance of Lovebird *Agapornis pullaria*

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ABSTRACT
This review aims to give an all-inclusive summary of the paramount factors influencing the breeding performance of lovebird Agapornis pullaria using hypothetical and experimental evidence provided in different literature and its influence on nestling success, and survival rate. Breeding performance simply refers to clutch size, hatching success, and nestling quality. However, age, Brood parasitism, clutch size, availability of food, human activities and microclimate influences breeding performance of the said species. Understanding the systems which pivot breeding performance in lovebird is fundamental to conservation. Therefore it becomes imperative for future researchers to examine the role of microclimate on hatchability of lovebirds in the wild as cavity nesting birds and the use of analytical models in determining the breeding performance of wild populations should be incorporated to stimulate better habitat management.
KEYWORDS: Lovebird, clutch size, food, age, microclimate

INTRODUCTION

Breeding performance in lovebird *Agapornis pullaria* can be defined as a total amount of nestlings that an average adult can nurture to a given stage or age for every breeding effort. It can also be defined in terms of clutch size, hatching success, and nestling quality [1, 2] without reservation.

Usually, evaluating the breeding performance of lovebird is basically combined with appraisal of adult continued existence (survival) rates, to promote better understanding of the health and condition of populations [2], in addition to the extent to which the avian species are likely to stick within a particular habitat during foraging and breeding period. Nine species of lovebirds are found in the sub-Saharan Africa, mainly in the woodlands of the island of Madagascar, South West Africa, north of the highlands of Ethiopia, Central Africa and West Africa each in its own distinct geographical area [3, 4].

Lovebirds are parrots and they belong to the order Psittaciformis, family; Psittacidae and species *Agapornis pullaria* [5]. Apart from that, they have a fragmented distribution with several populations in West Africa and they occupy lowland savannah and wood grassland [6]. Studying their breeding success can also be used as a performance based indicator in ecological restoration and monitoring programmes [2, 7, 8] which may invariably enhances future research on the said species as cavity nesting birds.

Consequently, this paper aims to give all-inclusive summary of the theoretical and experimental evidence provided in the literature to identify the paramount factors influencing breeding performance of Lovebird *Agapornis pullaria* and its implication on conservation programmes and prospective research in Africa at large.

AGE

In most cases, lovebirds commonly breed between the ages of ten months and five and they will continue breeding until up to six years of age. However in their natural habitat the starts breeding during dry season (March to April and June to July) and they usually nest communally [9]. But, survival and reproductive performances generally increase with age in bird species, before stabilizing at mid-age and declining in old individuals as an expression of senescence [10].

[10] and [11], suggested three main hypotheses to explain this pattern of performance in wild birds: first and foremost, the constraint hypothesis suggests that young individuals are less reproductively efficient due to inadequate reproductive experience, poor maturation of reproductive skills [10, 12], birds acquire and develop the necessary type of skills required to improve reproductive performance via experience

as they age, mainly their ability to forage, incubate, and care for their offspring [2, 13, 14].

Secondly, the restraint hypothesis suggests that breeding venture increases with age as the remaining reproductive value declines (mortality increases and fecundity decreases) and breeding proceedings become more evaluable [10, 12].

Thirdly the selection hypothesis suggests a progressive disappearance of low quality phenotypes, resulting to an increase of reproductive performance with age [10, 11, 12]. Phenotype in this context can be defined as the physical and physiological appearance of a lovebird for example brightly coloured head. As low phenotypes die off only superior individual are left behind which enhances proportional increase in reproductive performance with age in lovebird.

It is easily possible to identify the age of lovebirds even in a flock by mere observation especially those in captivity. Young ones from the age of five to ten months either in the wild or in captivity may breed, but if mating occurs between two birds of the same parents or bloodline. Inbreeding will retard the growth and survival ability [9] of the offspring.

The percentage of lovebird that is influence by phenotypic quality and age related enhancement on breeding performance is yet to be documented. Therefore subsequent research should focus on phenotypic quality and age related factors on breeding performance.

CLUTCH SIZE

Lovebirds may start mating from ten months of age and will produce a clutch of 4-6 eggs within 23 days. Like most of the tree-hole nesting species of birds, Lovebird's eggs are white in colour and are laid every other day. Clutch size ranges between 4 to 5 and the normal size of the eggs is 23.5 x 17 mm (0.9'' x 0.7'') [9], but putting their health and age of the birds into consideration, the eggs laid will range from 2 to 7. In most cases, a hen will not start incubating till the second or third egg is laid.

Clutch size is known to have an influence on the breeding performance of many species of birds including lovebird [2]. However, it is thought that in a good number of avian species, it has been adaptively regulated to promote efficient productivity and survival to an optimal level throughout their life time as part of a cost benefit strategy [2, 15]. Bird lays a specific number of eggs based on the mechanism controlling follicle growth and ovulation in the ovary, and the modification of this, is also controlled by internal and external factors. This is an approach to the problem of the proximate determination of clutch-size. On the other hand, evolutionary is also responsible for development of the size of the clutch [16].

According to [17], it appears to be widespread practice among breeders to withdraw nest boxes from couples after the females have laid a second or third consecutive clutch. This is done believing that, it reduces further laying and the physical exhaustion of females. It also prevents unsuccessful broods either because the embryos will be too weak to hatch, or the chicks will be too weak to survive thereby leading to poor breeding performance.

In captivity, lovebird can breed twice a year; however, it's highly recommended that a particular pair be given a season to rest. A female will willingly produce four clutches a year if given the chance. This type of breeding is unhealthy and will quickly result in an exhausted female that will have a short lifespan [18]. From all indication, breeding performance can be influenced based on number of clutches either in captivity or in the wild.

BROOD PARASITISM

Overtime research work has suggested that factors that influence condition on breeding ground especially those that limit productivity can have significant impact on population dynamics [19]. Brood parasitism, can be defined as a process where by a female deposits eggs in the nests of other female.

However, it is not too common in birds but it does exist. In a study carried out by [17], in five cases where seven and eight eggs/clutch occurred, two bonded females must had laid either three plus four eggs, or four plus four eggs, and both birds incubated in the same nest box. It was reported that, the fertilization rates of the clutches of the two "female-female pairs" were significantly lower than those of the clutches of the two "male-female. He

further observed that a clutch size of a particular couple was reduced by one egg.

It is extremely improbable that one of the mates had destroyed and eaten the missing egg in the clutch, while coincidentally another female in the group had laid an egg outside its own nest. Brood parasitism can also bring about poor breeding performance due to poor parental care for nestlings. Lovebird as a tree-hole dwelling species may be forced to practice brood parasitism due to high rate of deforestation and demand for timber by the populace resulting to inadequate tree cavity for breeding.

AVAILABILITY OF FOOD

Birds usually select foraging habitats based on the availability of their main prey items and understanding habitat preferences provides critical information for species conservation [4, 20]. From observation more Lovebird are sighted in forestland vegetation which is an intact forest with abundant food items [4] which promotes good breeding performance.

The availability and diversity of food also has an important role to play [21] and a comparison of vegetation between the areas where lovebirds forage and feed in the afternoons, and the Sanctuary area, enhances a better understanding of the role of food in sustenance of any wild population of birds, because without food the population will gradually cease.

From all indication, when food is overflowing, it triggers lovebird to start thinking about procreation (making babies). In the wild, they feed mainly on various grains, grass seeds, millet and sorghum *Sorghum bicolor*[2], certain types of tree bark, and also on small insects [9]. Water promotes digestion of food, dissolution of minerals and cooling. The way Lovebirds used waterholes differs from one season to another because of the role of water to life [21].

HUMAN INFLUENCE

From the study of [4] lovebirds' population was significantly higher in forestland vegetation than any other micro-habitat in the study area. The preference shown to forestland vegetation by lovebirds' populations was due to good breeding site, less or absence of human interference and more food resources available to enhance nurturing of nestling.

This was further proven by the result of diameter at breast height of tree species in the different micro-habitat. However, there is a highly significant difference in the diameter at breast of trees in Forestland vegetation to other micro-habitat. This in turn, proved the high preference of lovebirds to areas of more forest cover due to lower human interference in the micro-habitat [4, 22].

The development of subsistence farming, tree cutting, firewood collection, grass cutting, forest fires and cattle grazing are the potential threats to lovebirds' communities and possible breeding. Lovebird in particular are usually affected by indiscriminate deforestation which is a function of conversion of forest land to a crop land, firewood collection, logging of trees for timber, production of charcoal [4].

We know that birds are affected by urbanization as well, but the magnitude of these effects and whether they are positive or negative varies among birds [23, 24]. Most studies of the effects of development on birds focus on areas directly affected, where native habitats are altered or replaced by buildings and paved surfaces.

Reduced breeding success has been correlated to road proximity or road density for species ranging from warblers to vultures [25] and lovebirds cannot be an exception of this predicament. Bird community integrity has been shown to be strongly correlated to road-less area [25, 26]. A few species thrive under these conditions by exploiting the unique nesting and foraging opportunities that such environments provide [24] but, this is not applicable to lovebird as a tree-hole dwelling species. With habitat disturbance, indiscriminate felling of trees for timber production and mono-cropping more habitats are loss and more lovebirds will be exposed to poachers who are involved in traditional harvesting, especially less resistant species [4, 22]. However their breeding performance can also be altered if and only if such avian species must have initiated their breeding process by laying few eggs before been captured and taking into captivity as pet. Once birds are

caught and taking into captivity they may never have access to their eggs again. In most cases the eggs could be consumed by human especially children. Numerical effects of harvest primarily are restricted to sub-adult and floating adult components of the populations [27] which can also influence breeding performance of the said specie negatively.

Human activities associated with harvesting of lovebird *Agapornis pullaria* include blocking the mouth of a tree-hole and cutting it down, setting a platform of sticky gum by the tree-hole that catches the bird [4], and setting a cage with a life bird inside where the distress call by the bird attracts other bird to search for an entry into the cage. These methods of harvesting could pose a threat to the survival and breeding performance of lovebird [4, 28]. However, total of 2694 Lovebirds were taken into captivity within the study period [4].

Lovebirds' community usually develop migratory characteristic due to human presence and disturbance associated with farming activities during the day. Human disturbance on bird species will definitely force birds to feed on areas of less quality because survival rate and breeding success are influenced by food [22].

There is also growing evidence from continuous research indicating that birds are advancing their date of laying eggs interrelated with rising average temperatures. However, timing of laying has profound effects on overall breeding performance as there are often strong genetic [29] and phenotypic [30] in addition to timing of breeding and clutch size, which are key indicators of overall reproductive success in birds generally.

By modifying their time of breeding, climate change may likely alter some other aspects of reproduction processes such as the number of clutches [31] and size of clutches [32], incubation behaviour [33, 34], and recruitment [35. 36].

MICROCLIMATE

Lovebirds and climatic parameters shows, that there is a correlation between number of lovebirds and rainfall and such correlation is significant. Lovebird increases in time and space, with an increase in rainfall which stimulates availability of food source and decreases with decrease in rainfall which affected food sources directly [4]. The tree become luscious, flower and fruit during the late rainy season (August- October); therefore lovebird's distribution and abundance shows a strong correlation with rainfall and high relative humidity [22].

They are much more widely spread during the rainy season while they concentrate around the river during the hot dry months. Thus, the availability of water in the park is a key factor determining the species' distribution [37]. This suggested that water, food and good microclimate are key factors determining their distribution and promoting breeding performance. Apart from that, during the cold season more lovebirds are seen during the afternoon than in the evening [37] due to low environmental temperature. However, spermatogenesis in male birds takes place mostly at night, when body temperature is at its lowest ebb but, inappropriate microclimate in the nest cavities are probably responsible for hatching failure [17] in lovebirds during their breeding season. For better habitat improvement; microclimate, water and food should be put into consideration for lovebirds to breed optimally with low mortality.

CONCLUSION

From our review, so many factors are capable of influencing the breeding performance of lovebirds. These factors are multifaceted and habitat based. Understanding the systems which pivot breeding performance in lovebirds is fundamental to conservation of the said species.

Therefore it becomes imperative for future researchers to examine the role of microclimate on hatchability of lovebirds in the wild as cavity nesting bird. The use of analytical models in determining the breeding performance of wild populations should be incorporated also to stimulate better habitat management.

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